



GOVERNMENT OF INDIA
MINISTRY OF TOURISM AND CIVIL AVIATION
(Commission of Railway Safety)

RAILWAY ACCIDENT INVESTIGATION REPORT



ACCIDENT DUE TO FIRE ON ENGINE NO. 20066 WCM/1
AND COACH NO. CR 6365 WGSYCW ON 10 UP MADRAS-
BOMBAY MAIL AT BADLAPUR STATION ON
BOMBAY-PUNE BROAD GAUGE, DOUBLE
LINE, ELECTRIFIED SECTION OF
BOMBAY DIVISION,
CENTRAL RAILWAY

ON

8TH NOVEMBER, 1974

SUMMARY

Date	8th November, 1974
Time	4.35 hours.
Railway	Central.
Gauge	Broad—1676 mm.
Location	Badlapur station at Km. 67/27 on the Bombay-Pune Double Line Electrified Section.
Nature of Accident	Fire on Engine No. 20066 WCM/1 and Coach No. CR 6365 WGSYCW.
Train involved	10 Up Madras-Bombay Mail.
Consisting of	13 bogie coaches hauled by a WCM/1 type Electric locomotive.
Speed	Stationary.
System of operation	Absolute Block System.
Number of Tracks	Double Line (Electrified).
Gradient	1 in 580 falling.
Alignment	Straight.
Weather	Clear.
Visibility	Normal.
Casualties	Killed-Nil. Trivial-3.
Cause	Cause could not be determined. Probable cause was the failure of the insulation of 1500V incoming cable leading to the earthing switch in the HT compartment.
Responsibility	No one is held responsible.



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(Commission of Railway Safety)

FROM:

The Additional Commissioner of Railway Safety,
Central Circle,
Bombay.

TO:

The Secretary to the Government of India,
Ministry of Tourism & Civil Aviation,
Sardar Patel Bhavan,
New Delhi.

THROUGH:

The Commissioner of Railway Safety,
Lucknow.

SIR,

In accordance with Rule 4 of the Statutory Investigation into Railway Accidents Rules 1973 (published by the Ministry of Tourism & Civil Aviation under their Notification No. RS 13-T (8)/71 dated 19th April 1973), I have the honour to report the results of my Inquiry into the accident due to fire on 10 Up Madras-Bombay Mail at Badlapur station situated at Km. 67/27 on the Bombay-Pune Double Line Electrified Section of Central Railway at 4.35 hours on 8th November 1974.

Inspection and Inquiry

2. (a) On 14th November 1974 in company with the Additional Chief Operating Superintendent (Safety), Deputy Chief Electrical Engineer (Loco), Bombay, Senior Divisional Electrical Engineer (TRS II), Bombay, and officers of Bombay Division I inspected the site of the accident at Badlapur and the affected locomotive No. 20066 WCM/1 and Coach No. CR 6365 WGSYCW at Kalyan.

(b) A Press Notification was issued on 11th November, 1974 inviting the public who had information bearing on the accident to appear at the Inquiry which I held in the Divisional Superintendent's Office, Bombay, on 12th November 1974, or to communicate with me by Post.

(c) The Officers present at the Inquiry were :—

Shri F. Da Costa	. Additional Chief Operating Superintendent (Safety), Bombay.
Shri K.P. Padiyar	. Deputy Chief Electrical Engineer (Loco), Bombay.
Shri V.K. Chaudhary	. Senior Divisional Electrical Engineer (TRS II), Bombay.

The evidence of 12 witnesses, all railway employees, has been recorded.

The Accident

3. (a) On 8th November 1974, 10 Up Madras-Bombay Mail was stopped out of course at Badlapur station at about 4.27 hours for lighting the tail lamp which was found to have been extinguished. Within a few minutes after it stopped the Driver heard a loud report from the high tension compartment No. 2 of the locomotive. This was followed by a flash inside and the locomotive was on fire. The Driver immediately lowered the pantograph which caused heavy flash over and the contact wire parted and dropped. One end of the broken contact wire came to rest on the 2nd pantograph of the locomotive and on the roof of the first 2 coaches. The fire inside the locomotive continued. The 1st coach LR 4517 SR luggage-cum-brakevan, wooden bodied, was not affected, but the 2nd coach No. 6365 WGSYCW, 2nd class sleeper had a steel body and caught fire. The auxiliary catenary and the contact wires over the 2nd coach were ultimately found to have broken up into pieces. Fairly large holes were found in the roof of the 2nd coach apparently where the short circuit fire subsisted for some time. The end of the front portion of the parted contact wire was hanging with the tip about a metre above rail level.

(b) The fire extinguishers from the train and from the station and water and sand from buckets could not control the fire. The Municipal Fire Brigade was summoned from Kalyan and Ambarnath. The one from Ambarnath arrived at 5.05 hours and the fire was brought under control finally at about 9.00 hours.

Casualties

4. As a result of the accident 3 passengers sustained trivial injuries and were given medical aid by the Railway Doctor.

II. RELIEF MEASURES

Intimation and Medical Assistance

5. Immediately after the accident, the Assistant Station Master, Badlapur gave the information to all concerned at Bombay and Kalyan. Assistance in regard to medical aid and restoration of line was prompt.

Restoration

6. There was no derailment and through communication was not affected. Temporary

single line working was introduced on the section on both sides of Badlapur at 07.25 hours and normal double line working was resumed at 10.05 hours. After the front 3 coaches were detached passengers of 10 Up Madras-Bombay Mail continued their journey by the same train, which suffered a detention of 5 hours and 20 minutes as a result of the accident.

III. COMPOSITION OF TRAIN & DAMAGE

7. The composition of the train was as under:—

(a) **Engine.**—Locomotive No. 20066 WCM/1 type. Horse power 3700. Working on 1500 Volt D.C. Weight 124.8 tons. Length over buffers 20.83 Metres. Manufactured in 1955 by M/s English Electric Company, U.K. Equipped with regenerative and pneumatic brakes and fitted with Telco type speedometer chart.

(b) **Coaches.**—

Sl. No.	Coach No.	
1st	SR 4517 LR	Wooden bodied
2nd	CR 6365 WGSYCW	Steel bodied
3rd	CR 9045 WGSYCN	Ditto.
4th	SC 3362 WFC	Ditto.
5th	CR 3338 FCS	Ditto.
6th	NR 9113 WGSY	Ditto.
7th	SR 3997 WGSCWY	Ditto.
8th	SR 6499 WGSYCN	Ditto.
9th	SR 3901 GS	Ditto.
10th	SR 2966 WFC	Ditto.
11th	SR 5870 WFC	Ditto.
12th	CR 6039 SLR	Ditto.
13th	CR 6608 GSCG	Ditto.

(c) The train was fully vacuum braked. The length of the train over buffers including the engine was 302.4 metres and its weight was 634 tons.

(d) The seating/berth capacity of the train was 550 and the train was fully occupied.

Damage

8. On the locomotive the No-Current Relay panel was completely burnt out. The main earthing switch was also completely burnt as a result of the flash over and part of the burnt switch was in position. The cables connecting the equipment links on the No-Current Relay panel were melted up to the clamp. The second coach was completely burnt above the floor level. The cost of damage to railway assets was estimated at Rs. 4.06 lacs as under:—

(i) Locomotive	Rs. 2.5 lacs
(ii) Coaches	Rs. 1.5 lacs
(iii) Overhead equipment	Rs. 0.06 lacs
TOTAL	Rs. 4.06 lacs

IV. LOCAL CONDITIONS

The Site

9. (a) The direction of B.G. Double Line at the site of the accident is East to West coming towards Bombay. The kilometrage of the various stations reckoned from Bombay VT is as follows:—

(i) Bombay VT	Zero
(ii) Kalyan.	53.21 Kms.
(iii) Ambarnath	59.83 Kms.
(iv) Badlapur (Site of Accident)	67.27 Kms.
(v) Vangani	78.40 Kms.
(vi) Pune	191.59 Kms.

(b) The section is electrified and the traction voltage is 1500 Volt D.C. Badlapur station is a 'B' Class station equipped with Colour Light Signals to standard III.

(c) The 1500 Volt D.C. electric overhead supply at Badlapur is fed from the 3 nearest sub-stations, viz. the one at Badlapur itself, the one at Kalyan about 14 kilometres at one end and the one at Vangani 11 kilometres at the other end. At these sub-stations there are high speed circuit breakers which operate automatically whenever there is any heavy short circuit or fault current. The feeds are separate for the

Down line and for the Up line. Links provided in the circuit are operated to isolate the various lines.

(d) The maximum currents of the locomotive are of the order of 1700 amps. The High Speed Circuit Breakers (HSCB) at the sub-stations are normally rated to cut off supply whenever the current exceeds the setting value of between 3500 and 4000 amperes. If the total of all loads, that is faults and traction loads, exceeds the setting value the High Speed Circuit Breaker trips. In the case under reference while the High Speed Circuit Breaker at Kalyan sub-station opened out with an unusually loud noise and the High Speed Circuit Breaker at Badlapur tripped, the one at Vangani remained closed.

(e) Further more the sub-stations at Kalyan, Badlapur and Vangani can function unattended. The supervisory control room at Kalyan however has to be manned round the clock and keeps a log of the events on the system.

(f) The overhead equipment in the areas at Badlapur comprises the catenary wire of 0.5 sq. inches (320 sq. mm.) auxiliary catenary of 0.2 sq. inches (150 sq. mm.) section and contact wire

0.3 sq. inches (when new), suspended from OHE structures at intervals of 220 ft. (66 m.). The auxiliary catenary wire is suspended from the main catenary wire and the contact wire from the auxiliary.

(g) What is known as Supervisory Control system was installed at Kalyan from which it was possible to operate by remote control, any of the equipment installed at the various sub-stations

between Kalyan and Pune at one end and between Kalyan and Igatpuri at the other. However as a result of frequent theft of overland control wires of the system, the Supervisory Control system is no longer in use. In the case under reference it would have been possible to switch off from Kalyan the feeder which fed the current to the fault from Vangani end, if the Supervisory Control was functioning.

V. SUMMARY OF EVIDENCE

10. **Driver Shri H. P. Roach**, took over locomotive No. 20066 WCM/1 for working 10 Up Mail at Pune after it had completed its run on a Down goods train. He had 20 minutes late start ex: Pune due to late arrival of the train. Apart from this there was nothing unusual with the train right upto its arrival at Badlapur where it made an unscheduled halt on account of the Starter signal being against, at about 4.30 hours. When the train was waiting for the signal he heard a loud report at 4.35 hours followed by a heavy flash at No. 1 end inside the No. 2 high tension compartment which house the line breaker and camgroup equipments. The fire spread out on the engine in a moment. He dropped the pantograph thereby disconnecting the power supply. Meanwhile the overhead electrical wire had parted. The 2nd coach from the engine also caught fire. As the fire was of a very high intensity he could not move to fetch the fire extinguishers, all the 3 of which had been charged and kept ready for use. Subsequently the Fire Brigade came and brought the fire under control. The efforts of the station staff were of no avail.

11. **Assistant Driver Shri Gopal Singh** corroborated the statement given by the Driver.

12. **Guard, Shri T. B. Bhole** had recorded the load of the train as 13/519 tonnes ex: Pune. At Badlapur, he noticed that the engine and one coach were on fire. He took suitable action to detain the affected passengers, fight the fire and isolate the burning coach.

13. **OHE Sub-Inspector, Shri G. P. Joshi** on arrival at the site at about 04.55 hours observed that the OHE contact wire and the auxiliary catenary wire had parted at the location of the engine between Kms. 67/4-5. A portion was hanging in front of the engine about 3' above the rail level. A small piece of about 1 metre was lying on the track.

14. **Senior Operator, Kalyan, Shri R. V. Sawant** noticed that at 4.40 hours traction feeder No. 102 which feeds the Up line from Kalyan to Badlapur tripped off at Kalyan sub-station with a loud report. On account of the unusual nature of the loud report he suspected some trouble and did not take the usual step of closing the circuit breaker. He informed the Traction Power Controller and under his instructions kept the circuit breaker open. He was instructed to isolate the feeders at Kalyan and Badlapur and Feeder (No. 104) at Vangani. He opened Feeder No. 101 (Kalyan-Badlapur) and sent word through Vangani station to Assistant Ope-

rator Mishra and arranged to switch off the feeder of the affected line at about 05.25 hours. The Linesman at Badlapur reported at 04.55 hours that the Feeder (No. 102) was isolated.

15. **Divisional Mechanical Engineer (C&W), Shri R. C. Mathur** examined the 2nd coach No. CR 6365 WGSYCW which had caught fire, after it was brought to Kalyan. He noted the particulars namely POH 21-3-74, Return date 3/75. According to Shri Mathur the fire in the coach had originated from the ceiling as the roof and upper portion were completely burnt and distorted. The OHE wire had come in contact with the roof at 4 places along the longitudinal centre line with heavy sparking and burning of the roofing. The coach has been completely destroyed beyond economical repairs. The trolleys and underframes however had suffered hardly any damage.

16. **Assistant Electrical Engineer (TRS), Kalyan Shri K. Mallikarjuna** inspected the locomotive after it was brought to Kalyan at about 10.30 hours. He found that in No. 1 HT frame a flash over had taken place behind the No-Current Relay panel. The No-Current Relay panel had been completely burnt as also the main earthing switch. A part of the burnt switch was in position. The fire had destroyed all the camgroups and unit switches on that frame. The cables connecting the equipment links on the No-Current Relay panel were found melted upto the clamp. The earthing switch was in a closed position. On the roof of the locomotive pieces of contact wire were found fallen. He did not notice anything in the locomotive which could have caused the short circuit in the area where the fire apparently originated. According to him the only possible cause was failure of insulation of the cables connecting the links to the trolley overload relays.

The locomotive was given out for service after IOH on 1-11-74 and had actually started working trains from 2-11-74 onwards. Megger test during IOH had shown a resistance of 0.6 meg ohms in the high voltage wiring as against 0.5 permitted to be allowed by the shop supervising staff and 0.1 meg ohms permitted to be authorised by officers. He mentioned that there were other cases of heavy incidence of fire in the HT compartments of locomotives of WCM/1 and the other similar type of WCM/5 in the past. In respect of other types of locomotives viz. WCM/2, WCM/3, WCM/4 etc. however, the incidence

of such fires was much less. There were certain distinguishing features in respect of WCM/1 and WCM/5 type locomotive relevant to the potential causes of such fires. They were as follows:—

- (i) The cable which flashed over to the No-Current Relay panel connected the pantograph at the one end with the earthing switch and the links at the other. This cable was in an unprotected area inasmuch as there was no circuit breaker or fuse to protect against any fault currents unlike in the case of other types of locomotives where the earth fault relay was provided.
- (ii) The lay out of cables in HT compartment of WCM/1 & 5 types of locomotive was congested. In it there were 5 camgroups which fed the traction motors. Furthermore the panels were located at a right angle to the longitudinal axis of the locomotive and the traction motor cables passed underneath at the centre crossing many cables of HT compartment. Owing to lack of space the cables were bent very sharply at many places. They also pressed against each other and against the terminals at junction bars. In the congested space it was not possible to provide separators between the cables at crossing points for avoiding physical damage to the insulation.
- (iii) There was no separation of positive and negative cables as the lay out did not permit the same. Protected and unprotected cables ran very close permitting transfer of fault to unprotected portions in case of

fires. A small fire could thus result into a larger one.

While the cables might show adequate insulation during the test, with aging, the insulation was deteriorated in its composition and physically sometimes failed during service. Sharp bends and other physical stresses accentuated the situation.

The Administration had already taken the following steps in the matter.

- (a) Intensification of meggering of cables of high voltage and increasing the frequency of the tests.
- (b) Crimping of the connections instead of soldering whenever an opportunity arose.
- (c) Roof fuses were being fitted on WCM/1 type as an immediate step.
- (d) It was proposed to provide earth fault relays on WCM/1 type locomotives.
- (e) It was proposed to increase the clearance between the live wires and the panels or to provide insulation such as glass cloth to avoid flash over. For this purpose back connections on the No-Current Relay panels were being brought to the front.

He considered that the current system for location of fire extinguishers was not suitable as there was difficulty in getting access to them and also to the place of fire. They were trying out centralised equipment with 100 lbs CO₂ type cylinders which would be located in the driver's cab and pipes extended to HT compartment to be operated from the Driver's cab.

VI. DISCUSSION

Time of Accident

17. The Driver has given the time of the first loud report which caused the fire at 4.35 hours. The Senior Operator however has recorded that the traction feeder No. 102 tripped out with a loud report at 4.40 hours, apparently a little after the locomotive caught fire.

I accept 4.35 hours as the time of starting of the fire.

Speed

18. The train was stationary.

Location of the fire

19. The nature of the damage indicated that the flashover had taken place behind the No-Current Relay panel. The extent of damage was also the maximum at that location. Elsewhere there was no indication of the aftermaths of a flashover and the damaged equipment and cables had all the appearance of the consequences of an external fire. From these observations it is evident that the origin of the fire was at the incoming cables located behind the No-Current Relay panel.

The incoming cables located in this area were live whereas the cables and equipment beyond the main switch were dead as the train was stationary at the time the fire started. This factor

corroborates the conclusion that the fire started at the incoming cables.

These cables are not protected by any fuses or circuit breakers, which factor explains why the fire persisted and again corroborates the above conclusion.

Moreover records of the frequent fires which had taken place earlier in WCM/1 and similar type locomotives showed heavy incidence of fire in the area of the incoming cables and the above conclusion is in conformity with this pattern.

Considering that the cables in this area are old and have been known to fail due to deterioration, and considering that there is no likelihood of any outside body getting access to the cables when in service, it seems highly probable that the flash-over leading to the fire was due to the deteriorated and poor condition of the incoming cables.

Protection from the Sub-Stations

20. It is also to be noted that the heavy fault current caused tripping of the circuit breakers at Kalyan and at Badlapur, but not the one at Vangani. This resulted in the over head equipment being kept alive by the power being fed from Vangani resulting in the fire continuing for a long time. Had the circuit breaker at Vangani tripped, most of the fire would not most probably have continued to rage. This raises the question whether or not there was any defect in the

equipment. In this connection it is to be noted that the traction currents are fairly heavy in the case of 1500 V DC and consequently the rating of the High Speed Circuit Breaker. While the High Speed Circuit Breaker at Badlapur being nearest the fault naturally opened out, those at Kalyan and Vangani had to reckon with the resistance of the distance from the fault. In such circumstances it would not be unnatural that the High Speed Circuit Breaker at Kalyan, where there may have been other loads on the feeder, tripped, whereas the one at Vangani did not.

Delay in switching off power

21. Vide para 14 the Senior Operator at Kalyan had to send word to Operator Shri Mishra at Vangani through Vangani station for switching off the current from the Vangani Sub-Station. This naturally caused delay in the process which would have been avoided if Supervisory Control at Kalyan was functioning, (see para-9(g)). As an alternative to overland Control wires, underground cables could be used but these are no doubt costly. Whether the cost of laying the cables is justified or not will depend on the frequency of incidents of the above nature and the quantum of losses it will eliminate. This aspect would seem to merit a detailed study and action.

di/dt relays

22. The provision of di/dt relays at the Sub-stations which operate the circuit breakers in the

event of faults developing, has been one of the items discussed with the Railway Engineers. These relays operate on the basis of the rate of increase of current and as the fault currents usually develop at a faster rate than traction currents, the relays would afford a valuable protection. In those less frequent cases where the faults currents do not develop at the setting rate, the relays will not be an insurance against fires. This shortcoming would appear unavoidable.

Age of cables

It is known that with age the insulation of the cables deteriorates physically and (para 16) while meggering may show adequate resistance, all may not be well with the insulation. Some means of ascertaining the actual condition of cables in service and pending this, renewal of cables at suitable intervals are evidently called for.

Fire fighting

24. (Para 16) When a fire starts in a locomotive access to the location is usually difficult due to smoke and fumes. Even the portable fire extinguishers themselves may not be approachable. In the circumstances a centralised equipment operated from the cab and leading to all vital points seems to be the only way to fight fires.

VII. CONCLUSION

Cause

25. After full consideration of the factual, material and circumstantial evidence, I find that the exact cause of the fire could not be determined. The probable cause of the fire was the failure of the insulation of 1500 V incoming

cable leading to the earthing switch in the HT compartment.

Responsibilities

26. No one is held responsible.

VIII. REMARKS AND RECOMMENDATIONS

27. An out-door type HT fuse or circuit breaker should be provided on the roof of the locomotive between the pantograph and the isolating links (para 16).

28. Installation of di/dt relays (para 22) at sub-station is desirable. The installation of the relays on a programmed basis has been accepted by the Railway Board.

29. Cables particularly in unprotected areas, should be changed at regular intervals to be laid down from experience and observations, even if megger tests show satisfactory resistance. Al-

ternatively if norms could be fixed to assess the physical and general condition of the cables, the same could be adopted (para 23).

30. The lay out of cables in WCM/1 type locomotive should be simplified, and as far as possible that obtaining in WCM/2, 3 or 4 types adopted (para 16-ii).

31. Centralised fire fighting system with pipes leading to the vital equipment and to other sensitive points should be provided with means to operate the system from the driving cab at each end (para 24).

Yours faithfully,

Sd./-

(D. G. DIVGI)

*Additional Commissioner of Railway
Safety, Central Circle, Bombay.*

BOMBAY:

Dated 29th May 1975.

RAILWAY BOARD'S COMMENTS ON VARIOUS PARAS OF THE REPORT

Para 27 of the Report :—Instructions have been reiterated to the Central Railway to provide an outdoor HT fuse on WCM 5 locomotives also, if not already done.

Para 28 of the Report :—The Railway has been directed that procurement of di/dt relays for provision at sub-station should be taken up on high priority basis and necessary provision of funds should be made for this purpose within the budgetary allocation for the railways. It may please be added that over 100 di/dt relays have already been ordered as part of the scheme for augmentation of substation capacity and replacement of overaged rotary convertors, to cover 20 substations and some track cabins on the North East and South East ghat sections of the Central Railway. A major part of the supply has been completed and the balance is expected to be shipped shortly. The installation of these relays at the substations has already been taken up and is being carried out progressively, along with the substation works.

Para 29 of the Report :—The Problem of deterioration of cables on all types of WCM locomotives has already been probed by the Committee of Administrative Officers of the Central Railway in November, 1974. The Committee had observed that from the evidence available to them, it could be surmised that faults developed on only one circuit and the extensive damage was due to the physical spreading of flame due to burning rubber from faulty cables. The Committee had recommended that the existing design of the cable layout should be examined in detail and compressed asbestos protective shields or pipes installed between different cables wherever possible. The Committee was of the view that flame barrier of the type suggested above would help in containing the damage caused by such incidents in future. The Board had decided that

this should be examined at the time of recabbling of each class of locomotive.

RDSO have also revised cable specification which provides for use of flame retarding materials in the manufacture of cables used for electric rolling stock.

Condition of cables is thoroughly checked at the time of IOH and POH and cables changed on condition basis. For every class of locomotives, a special recabbling schedule is also carried out in case condition on some locomotive is found to be unsatisfactory.

Para 30 of the Report :—During recabbling of WCM-1 and WCM5 type of locomotives, provision is being made of Current, Balance Relay and the layout is being changed to make this relay less susceptible to fire. Arrangement has also been made for lowering the pantograph with operation of Current Balance Relay. This Relay is also being located as close as possible to the point of supply in HT-I Compartment. Space is also being provided for provision of high speed circuit breaker. Steps have also been taken for terminal bars; ducting of syndanio sheet is also being provided; arrangement are also being made to prevent oil of compressor coming in contact with cables; suitable drain is also being provided to take away the oil below the underframe; crimped terminals are being used; special attention is being paid to high current joints to avoid their overheating. Steps have also been taken to avoid water leakage in this type of locomotives.

Para 31 of the Report :—Necessary instructions have been issued to the railway to furnish the results of trials of centralised fire fighting system. These will be supplied to C.R.S. in due course.